Hazard Profile - Drought

Introduction[1, 2, 3, 4, 5, 6]

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Droughts are a natural part of the climate cycle. In the past century, Washington State has experienced a number of drought episodes, including several that lasted for more than a single season – 1928 to 1932, 1992 to 1994, and 1996 to 1997.

Unlike most states, Washington has a statutory definition of drought (Revised Code of Washington Chapter 43.83B.400). According to state law, an area is in a drought condition when:

- The water supply for the area is below 75 percent of normal.
- Water uses and users in the area will likely incur undue hardships because of the water shortage.

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters.

The National Drought Mitigation Center at the University of Nebraska-Lincoln uses three categories to describe likely drought impacts:

- Agricultural – Drought threatens crops that rely on natural precipitation.
- Water supply – Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard – Drought increases the threat of wildfires from dry conditions in forest and rangelands.

Additionally, drought also threatens the supply of electricity in our state. Hydroelectric power plants generated nearly three-quarters of the electricity produced in Washington State in 2000. When supplies of locally generated hydropower shrink because of drought, utilities seek other sources of electricity, and energy for power generation, which can drive up prices as well as reduce supply.

Unlike most disasters, droughts normally occur slowly but last a long time. Drought conditions occur every few years in Washington. The droughts of 1977 and 2001, the worst and second worst in state history, provide good examples of how drought can affect the state (see details below).

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion

annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. About 16,000 drinking water systems in Washington get water from the ground; these systems serve about 5.2 million people.

Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

A drought directly or indirectly affects all people and all areas of the state. A drought can result in farmers not being able to plant crops or the failure of the planted crops. This results in loss of work for farm workers and those in related food processing jobs. Other water or electricity dependent industries are commonly forced to shutdown all or a portion of their facilities resulting in further layoffs. A drought can spell disaster for recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) and for landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them. Also, people could pay more for water if utilities increase their rates. With much of Washington's energy coming from hydroelectric plants, a drought means less inexpensive electricity coming from dams and probably higher electric bills.

Probability of Future Occurrence[7]

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

In temperate regions, including Washington, current long-range forecasts of drought have limited reliability. In the tropics, empirical relationships have been demonstrated between precipitation and El Niño events, but few such relationships have been demonstrated above the 30º north latitude are yet understood; Washington sits between 45.30º and 49º north latitude. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

Based on the state's history with drought from 1895 to 1995 (see pages 12-15 for more), the state as a whole can expect severe or extreme drought at least 5 percent of the time In the future. All of Eastern Washington, except for the Cascade Mountain's eastern foothills, can expect severe or extreme drought 10 to 15 percent of the time. The east slopes of the Cascades and much of Western Washington can expect severe or extreme drought from 5 to 10 percent of the time.

Comparing the droughts of 1977 and 2001[8, 9]

The 1977 drought was the worst on record, but the 2001 drought came close to surpassing it in some respects. The following table has data on how the two droughts affected Washington by late September of their respective years.

Table 1. Comparison of Impacts of 1977 Drought and 2001 Drought Events

	1977 Drought	2001 Drought
Precipitation	Precipitation received at most locations ranged from 50 to 75 percent of normal levels, and in parts of Eastern Washington as low as 42 to 45 percent of normal.	Precipitation was 56 to 74 percent of normal. US Bureau of Reclamation – Yakima Project irrigators received only 37 percent of their normal entitlements, which allowed other water-right holders to get their needed supply. Elsewhere in the state, water users frequently subject to regulation to protect instream flow, found their supply interrupted much earlier than in a typical year. At the end of the irrigation season, 50,000 acre-feet of water was stored in the U.S. Bureau of Reclamation's five reservoirs, compared with 300,000 acre-feet typically in storage.
Wildland Fire	1,319 wildland fires burned 10,800 acres. State fire-fighting activities involved more than 7,000-man hours and cost more than $1.5 million.	1,162 wildland fires burned 223,857 acres. Firefighting efforts cost the state $38 million and various local, regional and federal agencies another $100 million.
Fish	In August and September 1977, water levels at the Goldendale and Spokane trout hatcheries were down. Fish had difficulties passing through Kendall Creek, a tributary to the north fork of the Nooksack River in Whatcom County.	A dozen state hatcheries took a series of drought-related measures, including installing equipment at North Toutle and Puyallup hatcheries to address low water flow problems.

Table 1. Comparison of Impacts of 1977 Drought and 2001 Drought Events

	1977 Drought	2001 Drought
Emergency Water Permits	Department of Ecology issued 517 temporary ground-water permits to help farmers and communities drill more wells.	Department of Ecology issued 172 temporary emergency water-right permits and changes to existing water rights.
Economic Impacts	The state's economy lost an estimated $410 million over a two-year period. The drought hit the aluminum industry hardest, with major losses in agriculture and service industries, including a $5 million loss in the ski industry. 13,000 jobs were lost because of layoffs in the aluminum industry and in agriculture.	The Bonneville Power Administration paid more than $400 million to electricity-intensive industries to shut down and remain closed for the duration of the drought. Thousands lost their jobs for months including 2,000-3,000 aluminum smelter workers at the Kaiser and Vanalco plants. The drought, combined with economic uncertainty, reduced energy supplies, and instability in energy markets elsewhere in the country, contributed to the job losses. Federal agencies provided more than $10.1 million in disaster aid to growers. More than $7.9 million in state funds paid for drought-related projects; these projects enabled the state to provide irrigation water to farmers with junior water rights and to increase water in fish-bearing streams.

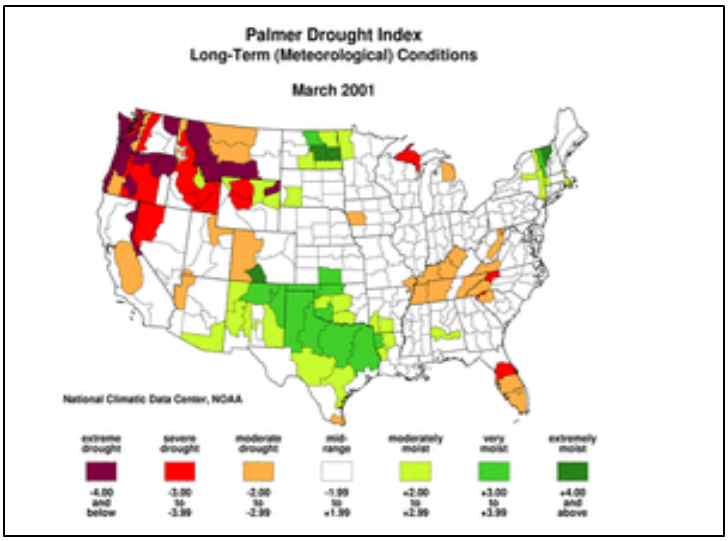
2001 Drought[10]

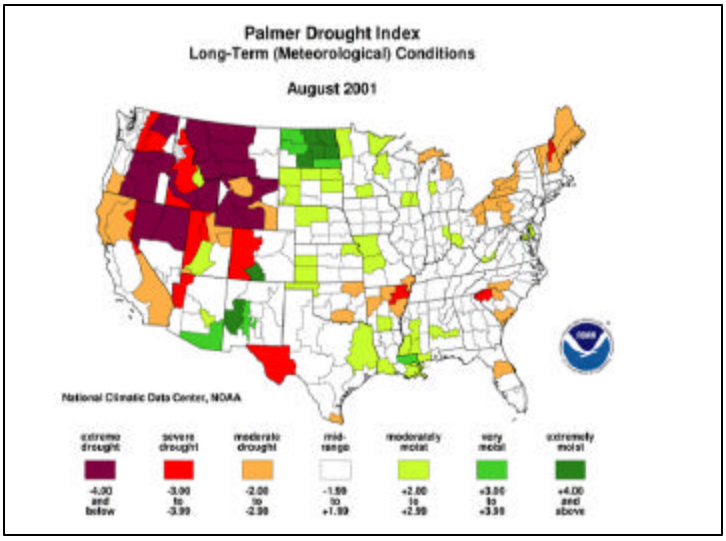
As the state began water year 2001 (October 1, 2000 – September 30, 2001), there was little reason to expect anything out of the ordinary. Climatologists had predicted cooler, wetter-than-normal weather for the Pacific Northwest.

While November and December 2000 were unusually dry, most experts assumed the typical heavy snow and rainfall levels would begin again in January 2001. However, the dry weather pattern continued through January and February, not returning to normal until March.

By mid-March, nearly every corner of the state was suffering from a water supply deficit. Between November 2000 and March 2001, the state received just 60 percent of normal rain and snowfall. The outlook for summer water supplies looked bleak. Federal, state and local officials worried low river flows would disrupt state hydroelectric power production and that dwindling water supplies would put various threatened and endangered fish species at risk.

On March 14, 2001, Gov. Gary Locke authorized the Department of Ecology to declare a statewide drought emergency; Washington was the first Northwest state to make such a declaration, which remained in effect until December 31, 2001.





The central part of the state, from the crest of the Cascade Mountains to the east banks of the Okanogan and Columbia Rivers, suffered the most from water shortages.

The Palmer Drought Index for March 2001, left top, graphically displays the height of drought conditions in Western Washington; the August 2001 index, left below, shows the height of drought conditions in Eastern Washington. These maps provide a comparison of drought conditions in Washington with those in the rest of the lower 48 states at the time.

The scale used for the Palmer Drought Index characterizes severe drought as having likely crop or pasture losses, very high fire risk, water shortages common with water restrictions imposed. An extreme drought has major crop and pasture losses, extreme fire danger, and widespread water shortages or restrictions.

Among the impacts of the 2001 drought:

- *Energy* – The drought decreased river flows, resulting in less electrical generation and tighter power supplies. Available out-of-state power was extremely expensive, causing higher rates and financial emergencies at many of the state's utilities. Bonneville Power Administration paid to keep electricity-intensive industries including aluminum smelters to shut down. Many small-scale power generators were placed into emergency service throughout the state.

- *Agriculture* – With stream flows below half of normal and groundwater levels threatened, there was significantly less water available for irrigation; irrigated

land produces about 70 percent of the state's crops. The Governor's drought order authorized the Department of Ecology to exercise emergency powers to:

- Issue temporary emergency water-rights permits and change existing water rights for farmers in 13 counties.
- Reduce mandated minimum stream flows in the Columbia River basin, helping 300 farmers and saving several million dollars worth of crops.
- Authorize emergency wells in the Yakima River basin.
- Lease water to improve instream flows and subsequently improve water supplies for farmers in the Roza irrigation and Kittitas reclamation districts.

- *Fish* – As the drought progressed, reduced stream flows caused numerous fish-passage problems on the American River, Rattlesnake Creek, and other Yakima River tributaries. Some fish stocks were lost. To help Columbia River fish populations, the Bonneville Power Administration paid growers in the basin to remove 75,000 acres from agricultural production; this kept additional water in the river during the most critical drought months. Improvements were made at a number of hatcheries, and salmon and steelhead were moved out of two hatcheries that experienced water problems.

- *Wildland fire* – Because of low moisture levels in forests, dry weather during the summer of 2001 resulted in 14 major fires that burned more than 178,000 acres of forest; total area burned was 223,857 acres.

Impact of Drought on the Washington's Agriculture Industry[11]

Agriculture is an important part of the state's economy, especially in rural Eastern Washington, which is more vulnerable to drought than is Western Washington.

In 1999, the food and agriculture industry and its supporting businesses employed more than 183,000 people in Washington. Farmers received more than $5.3 billion for their crops and livestock, and processed food products (such as juices, wine, French fries, candies, among other products) were valued at more than $8.9 billion.

Drought can affect the agriculture industry in a number of ways:

- It reduces crop production, sometimes for several years.

- It reduces availability of food on rangeland for grazing animals.

- It eliminates jobs in the field, at food processing plants and in affiliated facilities.

- It reduces availability of relatively inexpensive hydropower for farmers, processors, and storage facilities, increasing their reliance on more expensive energy sources.

- It increases shipping costs for some segments of the industry. For example, wheat growers may have to use truck and rail transport for a portion of their crop if the level of the Snake and Columbia Rivers become too low for barge traffic.

The impact of drought varies by region, by crop, and by the status of the irrigation water right holder (junior or senior). Loss of water is far more damaging to perennial crops, such as fruit trees, grapes, hops, and asparagus, than to annual crops because it takes perennials a number of years to return to normal production. Reducing irrigation on annuals such as corn, peas, and other vegetables not only results in loss of a crop for a year, but it also may result in the loss of the food-processing infrastructure because of lack of product or higher costs for hydropower or other energy source.

How important is water to agriculture? According the U.S. Geological Survey in its 1998 publication *Estimated Use of Water in the United States in 1995* (Circular 1200), three-quarters of the water consumed in Washington is used for irrigating crops.

Seventy-one percent of Washington's crops by value – $2.32 billion – are produced on irrigated land. The value of harvest per acre is 6.75 times greater on irrigated land than non-irrigated land; see Table 2, below.

Table 2. Value of Irrigated Crops

Harvested Crop Land	1997 Sales	Acres Harvested	Sales/ Acre	Sales % of Total	Acres % of Total
Irrigated	$2.3 billion	1.324 million	$1,755	71%	27%
Non-Irrigated	$927 million	3.572 million	$260	29%	73%
Total	$3.251 billion	4.896 million	$664	100%	100%

Source: U.S. Department of Agriculture, *1997 Census of Agriculture*

Among the key irrigated crops in the state are tree fruits, alfalfa hay, potatoes, and a variety of vegetables and sweet corn. According to the 1997 Census of Agriculture, Washington is the top producer of apples and pears in the nation, is the number two producer of cherries, plums, prunes and potatoes, fifth-ranked producer of vegetables, and 12th-ranked producer of alfalfa hay. Together, these crops consume about two-thirds of the water used for irrigation.

Drought affects more than the farm. It also can affect availability and cost of hydropower and of shipping capacity for crops dependent on water transport.

The cost of hydropower is critical to food processors; from 30 to 40 percent of the cost of processing and cold storage is for energy. Many processing companies originally located in the Pacific Northwest because of the region's low energy and water costs, which offset the costs of transportation to national and international markets. Low-cost power also resulted in development of new industry segments (e.g., the freezing industry led to growing of carrots, peas, sweet corn, and vegetables for use in frozen

packaging). Higher energy costs caused by drought remove local food processors' competitive edge. Food processing is a significant industry and employer in Washington – 1,150 food processors employed 41,400 people in 1999.

Low water flow in the Snake and Columbia Rivers can present problems for wheat growers, since more than 60 percent of their crop moves by barge. Lack of dredging combined with low river levels reduces capacity of barge transportation down river from Lewiston, forcing growers to use higher-cost alternatives such as trucking and rail. Similar river conditions also affect large bulk carriers that typically transport wheat and feed grains from Portland, Vancouver and Kalama to national and international markets.

Projected Economic Impact of Drought on Agriculture

In examining the impact of the 2001 drought, the Washington Department of Agriculture determined the potential long-term economic impact of cutting off water to a group of irrigators was five times the value of the lost harvest.

The analysis was based on the production of 330 farmers that irrigated and harvested nearly 38,000 acres of cropland in the Columbia-Snake River region. The analysis assumed:

- The farms would not receive sufficient water to maintain their plants for one year.
- Annual crop farmers, representing about 70 percent of the acres, suffered a single year loss.
- Perennial-crop farmers (apples, cherries, grapes, etc.) lost production for three to seven years.

Table 3, page 9, shows the value of the economic loss for these farmers was projected at $1.2 billion, with projected annual job losses ranging from 2,144 the first year to 643 in subsequent years; each $1 million in lost economic activity represents approximately 15 jobs.

Table 3. Economic Impact of Drought on 330 Irrigators in Columbia-Snake System

Year	Acres Affected	Value Lost Harvest		Replanting Cost		Total Direct Loss (millions)	Total Economic Loss (millions)	Job Loss		
		Harvest/ Acre	Value (millions)	Cost/ Acre	Value (millions)			On Farm	Related Jobs	Annual Total
2001	37,806	$1,755	$66.3	$350	$4.0	$70.3	$331.7	991	1,153	2,144
2002	11,342	$4,000	$45.4	$9,638	$109.3	$154.7	$226.8	297	346	643
2003	11,342	$4,000	$45.4	$858	$9.7	$55.1	$226.8	297	346	643
2004	11,342	$4,000	$45.4	$750	$8.5	$53.9	$226.8	297	346	643
2005	11,342	$4,000	$45.4	$184	$2.1	$47.5	$226.8	297	346	643
Total Harvest Loss			**$247.8**		**$133.6**	**$381.4**	**$1,239.1**			

Source: Washington Department of Agriculture, *The Impact of the 2001 Drought on Washington Agriculture*.

Jurisdictions Most Vulnerable to Drought[12]

Vulnerability to drought is affected by (among other things) population growth and shifts, urbanization, demographics, technology, water use trends, government policy, social behavior, environmental awareness, and economic ability to endure a drought. These factors evolve, and a community's vulnerability to drought may rise or fall in response to these changes. For example, increasing and shifting populations put greater pressure on water and other natural resources – more people need more water.

For the State Hazard Mitigation Plan, a county is most vulnerable to drought if it meets at least five of the following seven criteria:

- History of severe or extreme drought conditions:
  - The county must have been in serious or extreme drought at least 10-15 percent of the time from 1895 to 1995.

- Demand on water resources based on:
  - Acreage of irrigated cropland. The acreage of the county's irrigated cropland must be in top 20 in the state.
  - Percentage of harvested cropland that is irrigated. The percentage of the county's harvested cropland that is irrigated must be in top 20 in the state
  - Value of agricultural products. The value of the county's crops must be in the top 20 in the state.
  - Population growth greater than the state average. The county's population growth in 1990 – 2000 must be greater than state average of 21.2 percent.

- A county's inability to endure the economic conditions of a drought, based on:

- The county's median household income being less than 75 percent of the state median income of $45,776 in 1999.
- The county being classified as economically distressed in 2003 because its unemployment rate was 20 percent greater than the state average from January 2000 through December 2002.

The following counties meet the above criteria (supporting data is in the tables 4 through 9, below):

Adams	Benton	Chelan	Douglas	Franklin
Grant	Kittitas	Klickitat	Okanogan	Yakima

Counties Most At-Risk and Vulnerable to Drought

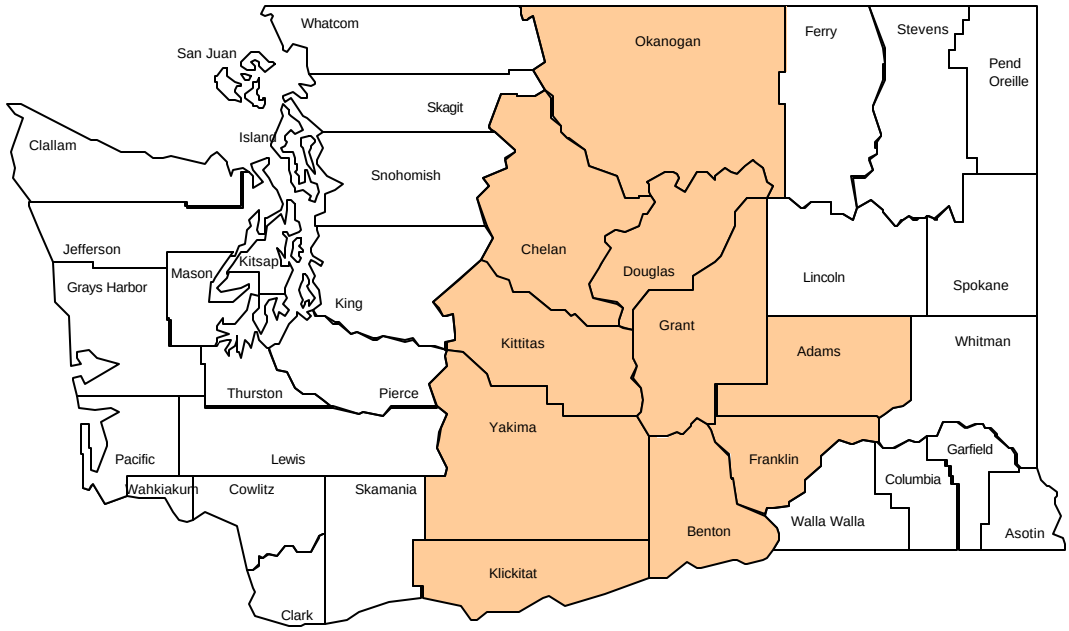


Table 4. Jurisdictions Most Vulnerable to Drought (in shaded rows)

County	% Time in Serious or Extreme Drought, 1895-1995	Acres Irrigated Cropland (State Rank)		% Harvested Cropland Irrigated (State Rank)		Market Value of Crops (State Rank)		Population Growth 1990 – 2000 (State Average = 21.1%)	Median Household Income =75% State Average of $45,776)	Distressed County (Unemployment =20% State Average)
Adams	10-15%	148,018	(5)	35.8%	(15)	$201,873,000	(7)	20.7%	$33,888	YES
Asotin	10-15%	329	(37)	0.9%	(37)	$9,743,00	(32)	16.7%	$33,524	NO
Benton	10-15%	153,254	(4)	55.8%	(8)	$300,530,000	(4)	26.5%	$47,044	NO
Chelan	10-15%	30,562	(10)	92.1%	(3)	$146,403,000	(10)	26.6%	$37,316	YES
Columbia	10-15%	3,565	(25)	3.3%	(36)	$24,477,000	(24)	1.0%	$33,500	YES
Douglas	10-15%	21,199	(12)	9.4%	(32)	$117,623,000	(13)	24.4%	$38,464	YES
Ferry	10-15%	4,667	(21)	35.9%	(14)	$5,013,000	(34)	15.3%	$30,388	YES
Franklin	10-15%	221,145	(3)	75.9%	(4)	$332,935,000	(3)	31.7%	$38,991	YES
Garfield	10-15%	693	(34)	0.6%	(39)	$24,685,000	(23)	6.6%	$33,398	NO
Grant	10-15%	446,183	(1)	78.7%	(4)	$804,252,000	(2)	36.3%	$35,276	YES
Kittitas	10-15%	75,859	(7)	129.9%	(1)	$79,634,000	(18)	24.8%	$32,546	NO
Klickitat	10-15%	20,239	(13)	22.6%	(19)	$33,231,000	(22)	15.2%	$34,267	YES
Lincoln	10-15%	47,984	(8)	9.8%	(31)	$107,808,000	(15)	14.9%	$35,355	NO
Okanogan	10-15%	47,679	(9)	65.1%	(6)	$133,521,000	(11)	18.6%	$29,726	YES
Pend Oreille	10-15%	1,583	(30)	10.9%	(29)	$2,879,000	(36)	31.6%	$31,677	YES
Spokane	10-15%	10,711	(14)	3.8%	(35)	$78,704,000	(19)	15.6%	$37,308	NO
Stevens	10-15%	9,997	(15)	15.0%	(28)	$22,815,000	(25)	29.5%	$34,673	YES
Walla Walla	10-15%	97,136	(6)	28.4%	(18)	$256,930,000	(5)	13.9%	$35,900	NO
Whitman	10-15%	5,469	(19)	0.7%	(38)	$173,483,000	(8)	5.1%	$28,584	NO
Yakima	10-15%	277,589	(2)	95.5%	(2)	$873,495,000	(1)	17.9%	$34,828	YES

History of Drought in Washington State

According to the National Drought Mitigation Center at the University of Nebraska-Lincoln, the Pacific Northwest region (Columbia, Willamette, and Snake River basins of Idaho, Oregon, and Washington, and portions of Montana and Wyoming) experiences drought more frequently than most other regions of the nation.

For purposes of examining drought frequency from 1895 through 1995, the drought center divided the nation into 18 regions generally corresponding to major river basin drainages. The Palmer Drought Severity Index, a measure of moisture supply, is used to determine drought conditions. The index determines that an area with a -3.0 to -3.99 rating is in severe drought, while an area with a -4.0 or greater rating is in extreme drought.

Figures produced by the National Drought Mitigation Center show that the Pacific Northwest had 10 percent or more of its area in severe or extreme drought during 61 years of the 100-year period. Only the Missouri basin of the north-central United States and the Great Basin of Nevada and Utah had more years with 10 percent or more of its area experiencing severe or extreme drought, 70 years and 65 years, respectively.

When severe or extreme drought covered a third of its area, the Pacific Northwest was in this condition 33 years of the 100-year period. Only two other regions had a third of their areas in drought more often than the Pacific Northwest – the Great Basin (37 years) and the Upper Colorado (34 years). The Missouri basin also was in this condition 33 years out of the 100-year period.

When severe or extreme drought covered two thirds of its area, the Pacific Northwest was in this condition 14 years out of 100. Again, only two other regions – the Upper Colorado (25 years) and Tennessee (16 years) – were in this condition more frequently than the Pacific Northwest.

Drought affects all areas of the state, but at different levels; the wetter, west side of the state experiences drought conditions less often, and less severely, than does the drier, east side of the state.

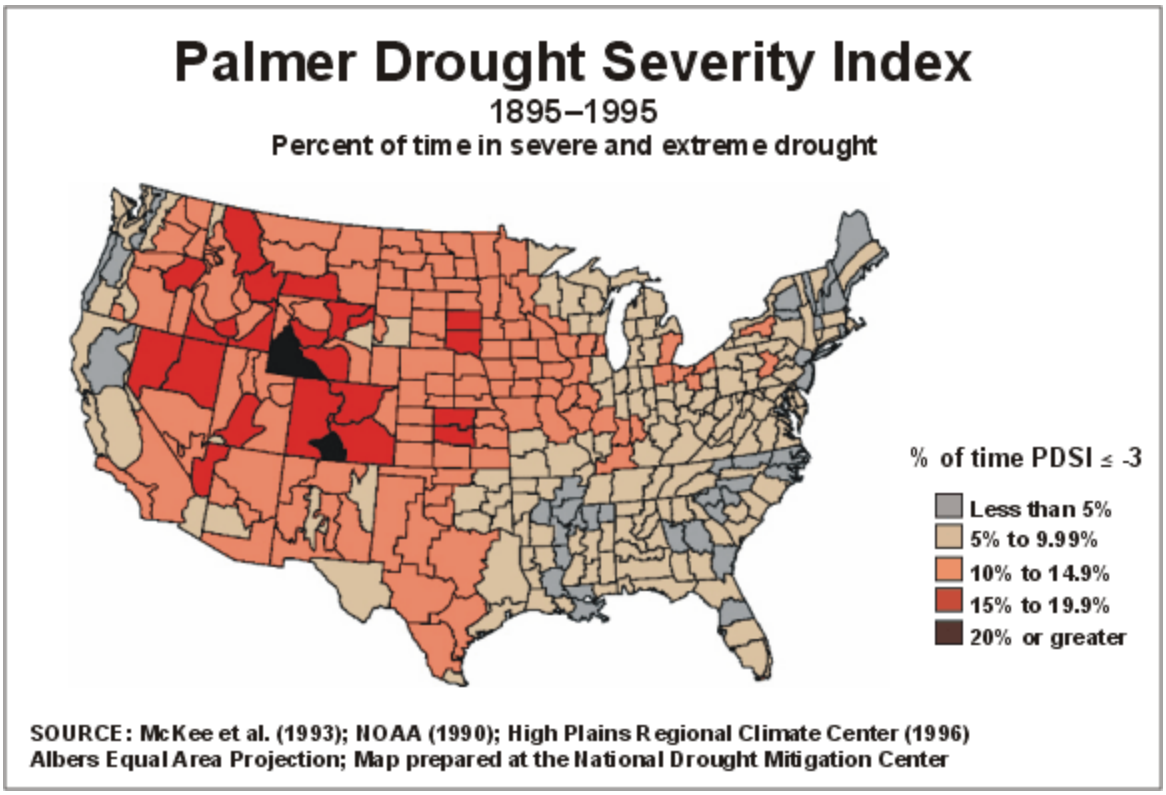
During 1895-1995, much of the state was in severe or extreme drought at least 5 percent of the time. All of Eastern Washington, except for the Cascade Mountain's eastern foothills, was in severe or extreme drought (See Palmer Drought Severity Index 1895-1995 map, page 14) 10 to 15 percent of the time. The east slopes of the Cascades and much of Western Washington was in severe or extreme drought from 5 to 10 percent of the time.

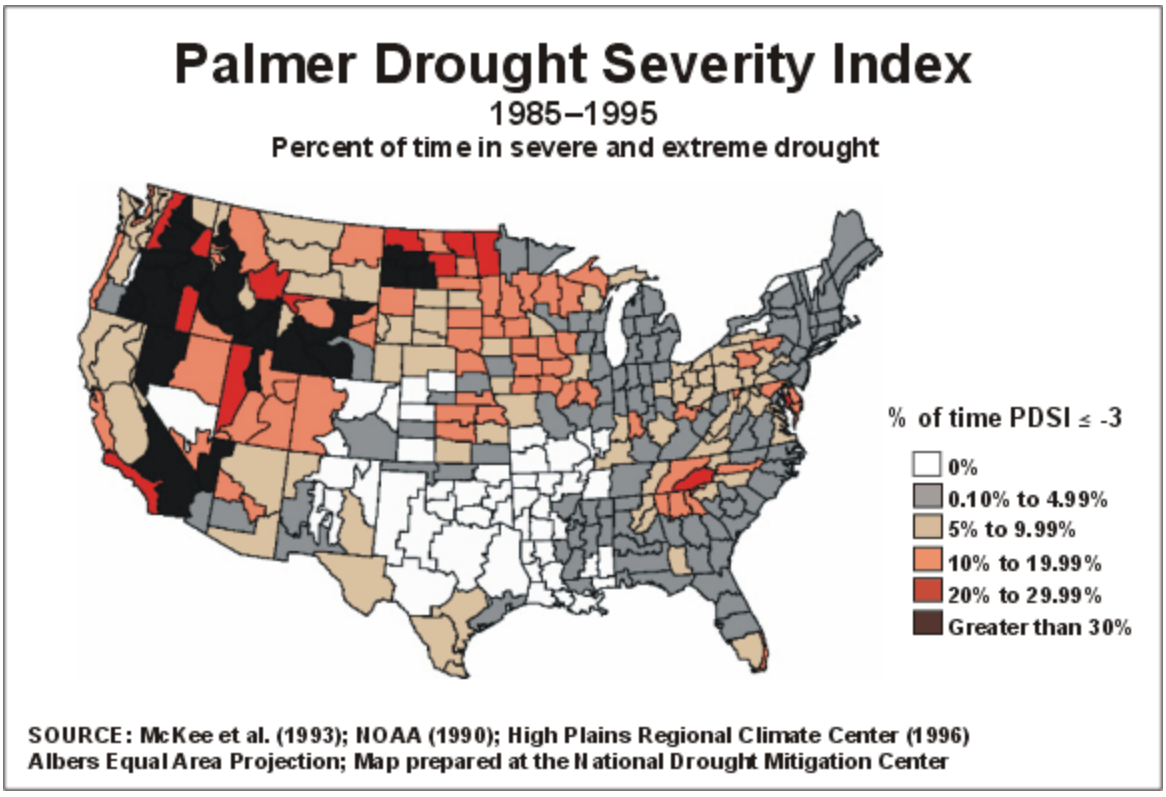
Many of the same counties experienced serious or extreme drought conditions from 1985 to 1995 and during the 1977 drought episode. Table 5, page 13, shows how much time each of Eastern Washington's counties has been in serious or extreme drought:

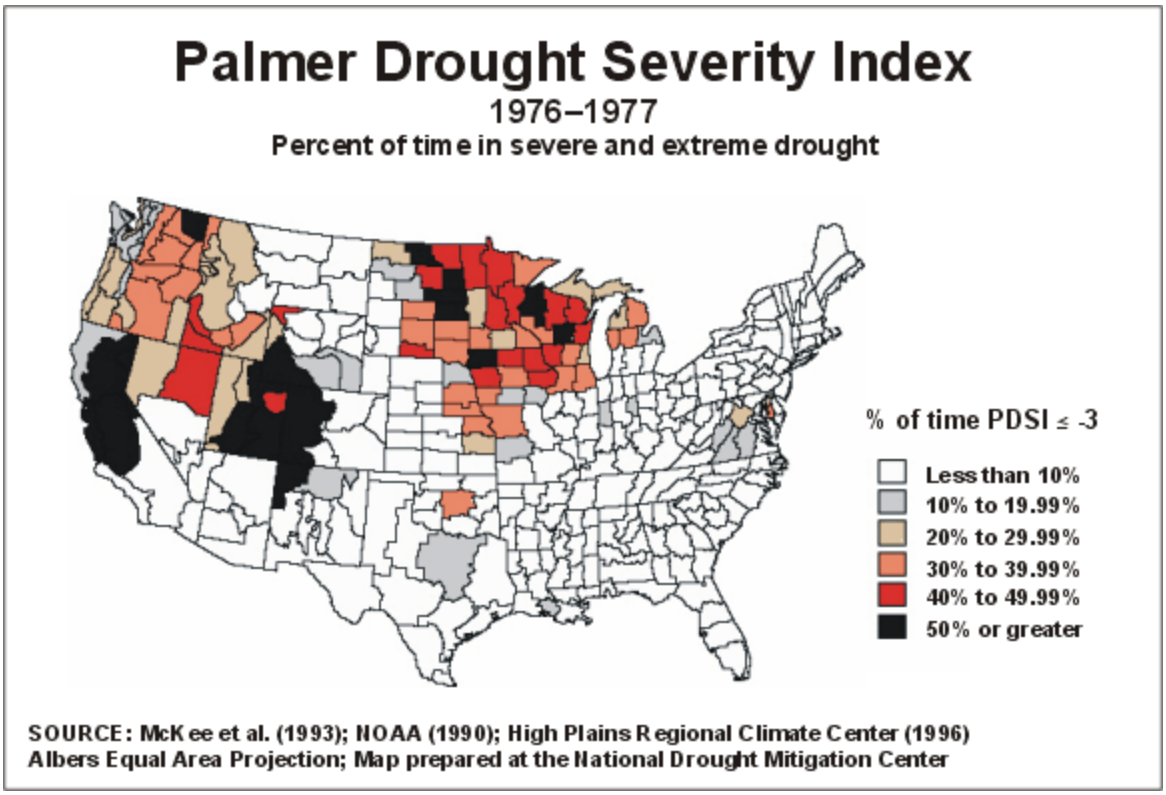
Table 5. Serious or Extreme Drought Conditions in Washington Counties

County	% Time in Drought 1895-1995	% Time in Drought 1985-1995	% Time in Drought 1976-77
Adams	10-15%	20-30%	30-40%
Asotin	10-15%	20-30%	30-40%
Benton	10-15%	> 30%	30-40%
Chelan	10-15%	> 30%	30-40%
Columbia	10-15%	20-30%	30-40%
Douglas	10-15%	> 30%	30-40%
Ferry	10-15%	5-10%	> 50%
Franklin	10-15%	20-30%	30-40%
Garfield	10-15%	20-30%	30-40%
Grant	10-15%	> 30%	30-40%
Kittitas	10-15%	> 30%	30-40%
Klickitat	10-15%	> 30%	30-40%
Lincoln	10-15%	20-30%	30-40%
Okanogan	10-15%	> 30%	> 50%
Pend Oreille	10-15%	5-10%	> 50%
Spokane	10-15%	20-30%	30-40%
Stevens	10-15%	5-10%	> 50%
Walla Walla	10-15%	20-30%	30-40%
Whitman	10-15%	20-30%	30-40%
Yakima	10-15%	> 30%	30-40%

Source: *National Drought Mitigation Center*, see maps below.


Palmer Drought Severity Index
1895–1995
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
Less than 5%
5% to 9.99%
10% to 14.9%
15% to 19.9%
20% or greater
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center


Palmer Drought Severity Index
1985–1995
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
0%
0.10% to 4.99%
5% to 9.99%
10% to 19.99%
20% to 29.99%
Greater than 30%
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center


Palmer Drought Severity Index
1976–1977
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
Less than 10%
10% to 19.99%
20% to 29.99%
30% to 39.99%
40% to 49.99%
50% or greater
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

Irrigated Cropland

Table 6, below, shows the 20 counties that irrigate the greatest percentage of their harvested cropland, and the total value of their agricultural products.

Table 6. Top 20 Irrigation Counties in Washington State

County	Acres of Harvested Cropland	Acres of Irrigated Cropland	% of Cropland Irrigated	Market Value of Products	Value of Products National Ranking
Kittitas *	58,409	75,859	129.9%	$79,634,000	
Yakima	290,534	277,589	95.5%	$873,495,000	10th
Chelan	33,167	30,562	92.1%	$146,403,000	
Grant	566,807	446,183	78.7%	$804,252,000	14th
Franklin	291,241	221,145	75.9%	$332,935,000	55th
Okanogan	73,261	47,679	65.1%	$133,521,000	
Clallam	5,901	3,770	63.9%	$6,011,000	
Benton	274,855	153,254	55.8%	$300,530,000	64th
Pacific	6,932	3,367	48.6%	$16,964,000	
Whatcom	60,715	25,792	42.5%	$241,643,000	95th
Cowlitz	7,882	3,231	41.0%	$15,919,000	
Pierce	12,592	5,149	40.9%	$69,835,000	
Thurston	14,831	5,564	37.5%	$120,712,000	
Ferry	12,994	4,667	35.9%	$5,013,000	
Adams	413,299	148,018	35.8%	$201,873,000	
Jefferson	2,542	847	33.3%	$4,321,000	
King	10,591	3,291	31.1%	$93,791,000	
Walla Walla	342,371	97,136	28.4%	$256,930,000	81st
Klickitat	89,643	20,239	22.6%	$33,231,000	
Skamania	1,206	272	22.6%	$1,532,000	

* – Kittitas County's irrigated cropland figure includes lands used for pasture, grazing, cover crops and other uses not directly related to harvested crops.

Source: *US Department of Agriculture, 1997 Census of Agriculture.*

Counties Growing Faster Than State Average, 1990-2000

The U.S. Geological Survey's water use figures for Washington State show that public supply – domestic, commercial, industrial, and thermoelectric generation – uses about one gallon in eight.

Growing counties will find their rate of water use grow with as their population grows; Table 7, below, shows the counties whose population grew faster than the state's 21.1 percent between 1990 and 2000, and therefore, likely will experience a greater demand for water than the state average.

Table 7. Population Growth

County	Average Growth 1990-2000
Clark	45.0%
San Juan	40.2%
Grant	36.3%
Franklin	31.7%
Pend Oreille	31.6%
Whatcom	30.5%
Snohomish	30.2%
Skagit	29.5%
Stevens	29.5%
Mason	28.9%
Thurston	28.6%
Jefferson	27.1%
Chelan	26.6%
Benton	26.5%
Kittitas	24.8%
Douglas	24.4%
Kitsap	22.3%
State Average	*21.1%*

Source*: U.S. Census Bureau, Census 2000.*

Household Income of Counties, 1999

Table 8, below, shows those counties whose median household income is less than or equal to 75 percent of the state median income in 1999. Median income is that income level at which half of the household incomes in the county are larger and half are smaller.

Table 8. Median Household Income = 75% of State Average

State Average	*$44,776*
75% State Average	*$34,332*
Klickitat	$34,267
Grays Harbor	$34,160
Adams	$33,888
Asotin	$33,524
Columbia	$33,500
Garfield	$33,398
Kittitas	$32,546
Pend Oreille	$31,677
Pacific	$31,209
Ferry	$30,388
Okanogan	$29,726
Whitman	$28,584

Source*: U.S. Census Bureau, Census 2000.*

Economically Distressed Counties, 2003

Table 9, below, lists the counties classified as economically distressed in 2003, based on their unemployment rate being at least 20 percent greater than the state's average unemployment rate during the January 2002 – December 2002 period.

Table 9. Economically Distressed Counties, 2003

County	Unemployment Rate
State Average	*6.3%*
State Average plus 20 percent	*7.6%*
Klickitat	13.4%
Ferry	13.2%
Columbia	11.1%
Okanogan	10.8%
Yakima	10.7%
Skamania	10.5%
Adams	10.3%
Stevens	10.1%
Grant	9.9%
Grays Harbor	9.9%
Pend Oreille	9.5%
Cowlitz	9.4%
Franklin	9.1%
Lewis	9.1%
Chelan	9.0%
Pacific	8.6%
Douglas	7.8%
Mason	7.7%
Clallam	7.6%

Source: Washington Department of Employment Security, Labor Market and Economic Analysis Branch, April 1, 2003.

State Agency Facilities At Risk			PRELIMINARY ASSESSMENT
Number and Function of Buildings	**No. of Affected Staff / Visitors / Residents**	**Approx. Value of Owned Structures**	**Approx. Value of Contents All Structures**
Total at-risk buildings: State agencies participating in the plan have identified 251 facilities that potentially could be affected by the secondary impacts of drought – water and electricity shortages, etc. Drought causes little damage to structures.	12,125	$295,367,385	$136,989,391
Function of at-risk buildings: Among the facilities identified as potentially at risk are the campuses of Big Bend Community College Lake and Eastern State Hospital;12 state liquor stores and other enforcement offices; eight driver licensing offices; and a variety of general offices and client services offices, including WorkSource employment and training centers and offices serving individuals and families on public assistance..			
More detailed narratives on facilities at risk can be found in the Region profiles, Tab 7.2.1 – Tab 7.2.9.			
Total at-risk critical facilities: State agencies participating in the plan have identified 93 critical facilities that potentially could be affected by the secondary impacts of drought – water and electricity shortages, etc. Drought causes little damage to structures.	4,113	$202,000,000	$99,945,000
Function of at-risk critical facilities: Among the facilities identified as potentially at risk is the campus of Eastern State Hospital, and a number of general office and client services offices.			

[1] *Washington State 2001 Hazard Identification and Vulnerability Assessment*, Washington State Military Department, Emergency Management Division, April 2001.

[2] Curt Hart, et al., *2001 Drought Response, Report to the Legislature*, Washington Department of Ecology Water Resources Program, Publication No. 01-11-017, December 2001.

[3] *Planning for Drought: Why Plan for Drought*, National Drought Mitigation Center, University of Nebraska – Lincoln, <http://www.drought.unl.edu/plan/whyplan.htm>, (April 2, 2003).

[4] *Science of Drought*, Washington Department of Ecology Water Resources Program, <http://www.ecy.wa.gov/programs/wr/drought/droughtscience.html>, (April 2, 2003).

[5] *Focus: Drought in Washington State*, Washington Department of Ecology, 2001, <http://www.ecy.wa.gov/pubs/0111003.pdf>, (June 20, 2003).

[6] *2003 Biennial Energy Report – Energy Strategy Update: Responding to the New Electricity Landscape*, Washington Department of Community Trade and Economic Development, Energy Policy Division, February 2003.

[7] *What is Drought: Predicting Drought*, National Drought Mitigation Center, University of Nebraska – Lincoln, < http://www.drought.unl.edu/whatis/predict.htm>, (April 2, 2003).

[8] Mary Getchell, *Drought Update: Final Review of the 2001 Drought*, Washington Department of Ecology, news release 01-168, September 25, 2001, <http://www.ecy.wa.gov/news/2001news/2001-168.html>, (April 2, 2003).

[9] Curt Hart, et al., *2001 Drought Response, Report to the Legislature*, Washington Department of Ecology Water Resources Program, Publication No. 01-11-017, December 2001.

[10] Ibid.

[11] William E. Brookreson and Linda Crerar, *The Impact of the 2001 Drought on Washington Agriculture*, Washington Department of Agriculture, April 3, 2001.

[12] *Planning for Drought: Why Plan for Drought*, National Drought Mitigation Center, University of Nebraska – Lincoln, <http://www.drought.unl.edu/plan/whyplan.htm>, (April 2, 2003).